Mellanox ConnectX-3 and ConnectX-3 Pro Adapters for System x
Product Guide

High-performance computing (HPC) solutions require high bandwidth, low latency components with CPU offloads to get the highest server efficiency and application productivity. The Mellanox ConnectX-3 and ConnectX-3 Pro network adapters for System x® servers deliver the I/O performance that meets these requirements.

Mellanox's ConnectX-3 and ConnectX-3 Pro ASIC delivers low latency, high bandwidth, and computing efficiency for performance-driven server applications. Efficient computing is achieved by offloading from the CPU routine activities, which makes more processor power available for the application. Network protocol processing and data movement impacts, such as InfiniBand RDMA and Send/Receive semantics, are completed in the adapter without CPU intervention. RDMA support extends to virtual servers when SR-IOV is enabled. Mellanox's ConnectX-3 advanced acceleration technology enables higher cluster efficiency and scalability of up to tens of thousands of nodes.

Figure 1. Mellanox Connect X-3 10GbE Adapter for System x (3U bracket shown)

Did you know?

Mellanox Ethernet and InfiniBand network server adapters provide a high-performing interconnect solution for enterprise data centers, Web 2.0, cloud computing, and HPC environments, where low latency and interconnect efficiency is paramount. In additiona, Virtual Protocol Interconnect (VPI) offers flexibility in InfiniBand and Ethernet port designations.

With the new ConnectX-3 Pro adapter, you can implement VXLAN and NVGRE offload engines to accelerate virtual LAN ID processing, ideal for public and private cloud configurations.

Part number information

Table 1 shows the part numbers and feature codes for the adapters.

Table 1. Ordering part numbers and feature codes

Part number	Feature code	Description
00D9690	A3PM	Mellanox ConnectX-3 10 GbE Adapter
00D9550	A3PN	Mellanox ConnectX-3 40GbE / FDR IB VPI Adapter
00FP650	A5RK	Mellanox ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter

The part numbers include the following:

- One adapter with a bracket attached
- Additional bracket included in the box
- Quick installation guide
- Documentation CD
- Warranty Flyer
- Important Notices Flyer

Figure 2 shows the Mellanox ConnectX-3 40GbE / FDR IB VPI Adapter (the shipping adapter includes a heatsink over the ASIC but the figure does not show this heatsink)

Figure 2. Mellanox ConnectX-3 40GbE / FDR IB VPI Adapter for System x with 3U bracket (required ASIC heatsink not shown)

Supported cables and transceivers

The 10GbE Adapter (00D9690) supports the direct-attach copper (DAC) twin-ax cables, transceivers, and optical cables that are listed in the following table.

Table 2. Supported transceivers and DAC cables - 10GbE adapter

Part number	Feature code	Description
Direct Attach Copper (DAC) cables		
00D6288	A3RG	.5 m Passive DAC SFP+ Cable
90Y9427	A1PH	1 m Passive DAC SFP+ Cable
90Y9430	A1PJ	3 m Passive DAC SFP+ Cable
90Y9433	A1PK	5 m Passive DAC SFP+ Cable
00D6151	A3RH	7 m Passive DAC SFP+ Cable
95Y0323	A25A	1M Active DAC SFP+ Cable
95Y0326	A25B	3m Active DAC SFP+ Cable
95Y0329	A25C	5m Active DAC SFP+ Cable
SFP+ Transceivers		
46C3447	5053	SFP+ SR Transceiver
45W2411		SFP+ Transceiver 10 Gbps SR (IB-000180)
49Y4216	0069	Brocade 10Gb SFP+ SR Optical Transceiver
49Y4218	0064	QLogic 10Gb SFP+ SR Optical Transceiver
Optical Cables		
88Y6851	A1DS	1 m LC-LC Fiber Cable (networking) - Optical
88Y6854	A1DT	5 m LC-LC Fiber Cable (networking)- Optical
88Y6857	A1DU	25 m LC-LC Fiber Cable (networking) - Optical

The FDR VPI IB/E Adapter (00D9550) and and ML2 Adapter (00FP650) support the direct-attach copper (DAC) twin-ax cables, transceivers, and optical cables that are listed in the following table.

Table 3. Supported transceivers and DAC cables - 40GbE adapters

Part number	Feature code	Description
Direct attach copper (DAC) cables - InfiniBand		
44T1364	ARZA	0.5m Mellanox QSFP Passive DAC Cable
00KF002	ARZB	0.75m Mellanox QSFP Passive DAC Cable
00KF003	ARZC	1m Mellanox QSFP Passive DAC Cable
00KF004	ARZD	1.25m Mellanox QSFP Passive DAC Cable
00KF005	ARZE	1.5m Mellanox QSFP Passive DAC Cable
00KF006	ARZF	3m Mellanox QSFP Passive DAC Cable
Optical cables - InfiniBand		
00KF007	ARYC	3m Mellanox Active IB FDR Optical Fiber Cable
00KF008	ARYD	5m Mellanox Active IB FDR Optical Fiber Cable
00KF009	ARYE	10m Mellanox Active IB FDR Optical Fiber Cable
00KF010	ARYF	15m Mellanox Active IB FDR Optical Fiber Cable
00KF011	ARYG	20m Mellanox Active IB FDR Optical Fiber Cable
00KF012	ARYH	30m Mellanox Active IB FDR Optical Fiber Cable
40Gb Ethernet (QSFP) to 10Gb Ethernet (SFP+) Conversion		
00KF013	ARZG	3m Mellanox QSFP Passive DAC Hybrid Cable
00D9676	ARZH	Mellanox QSFP to SFP+ adapter
40Gb Ethernet (QSFP) - 40GbE copper uses the QSFP+ to QSFP+ cables directly.		
74Y6074 / 49Y7890	A1DP	1 m QSFP+ to QSFP+ Cable
74Y6075 / 49Y7891	A1DQ	3 m QSFP+ to QSFP+ Cable
00D5810	A2X8	5m QSFP-to-QSFP cable
00D5813	A2X9	7m QSFP-to-QSFP cable
40Gb Ethernet (QSFP) - 40GbE optical uses QSFP+ transceiver with MTP optical cables		
49Y7884	A1DR	QSFP+ 40GBASE-SR4 Transceiver
90Y3519	A1MM	10 m QSFP+ MTP Optical cable
90Y3521	A1MN	30 m QSFP+ MTP Optical cable

The following figure shows the Mellanox ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter.
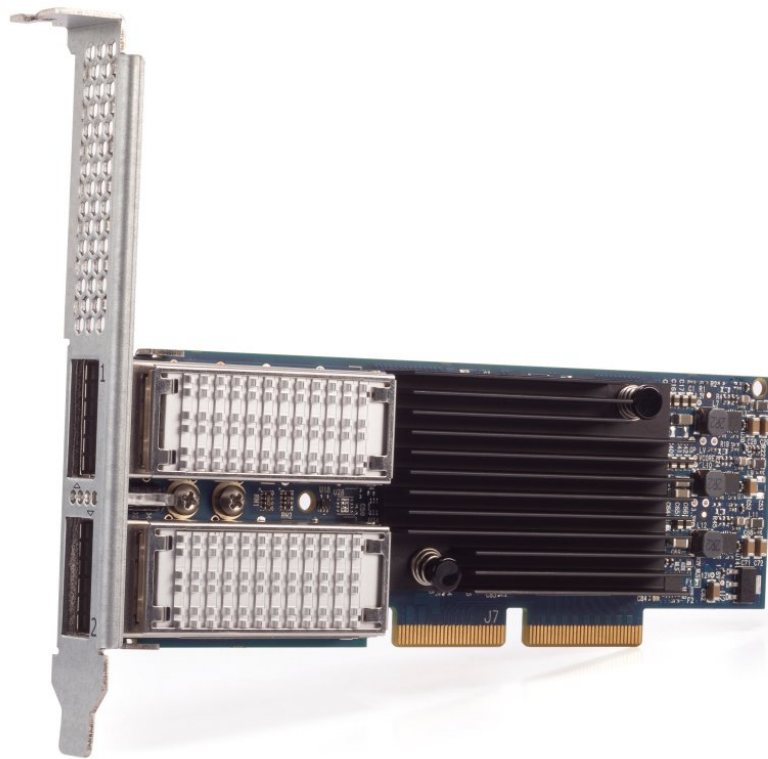

Figure 3. Mellanox ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter

Features

The Mellanox Connect X-3 10GbE Adapter has the following features:

- Two 10 Gigabit Ethernet ports
- Low-profile form factor adapter with 2U bracket (3U bracket available for CTO orders)
- PCI Express 3.0 x8 host-interface (PCIe 2.0 and 1.1 compatible)
- SR-IOV support; 16 virtual functions supported by KVM and Hyper-V (OS dependant) up to a maximum of 127 virtual functions supported by the adapter
- Enables Low Latency RDMA over Ethernet (supported with both non-virtualized and SR-IOV enabled virtualized servers) -- latency as low as 1 ?s
- TCP/UDP/IP stateless offload in hardware
- Traffic steering across multiple cores
- Intelligent interrupt coalescence
- Industry-leading throughput and latency performance
- Software compatible with standard TCP/UDP/IP stacks
- Microsoft VMQ / VMware NetQueue support
- Legacy and UEFI PXE network boot support
- Supports iSCSI as a software iSCSI initiator in NIC mode with NIC driver

The Mellanox ConnectX-3 40GbE / FDR IB VPI Adapter has the following features:

- Two QSFP ports supporting FDR-14 InfiniBand or 40 Gb Ethernet

- Low-profile form factor adapter with 2U bracket (3U bracket available for CTO orders)
- PCI Express 3.0 x8 host-interface (PCIe 2.0 and 1.1 compatible)
- Support for InfiniBand FDR speeds of up to 56 Gbps (auto-negotiation FDR-10, DDR and SDR)
- Support for Virtual Protocol Interconnect (VPI), which enables one adapter for both InfiniBand and 10/40 Gb Ethernet. Supports three configurations:
  - 2 ports InfiniBand
  - 2 ports Ethernet
  - 1 port InfiniBand and 1 port Ethernet
- SR-IOV support; 16 virtual functions supported by KVM and Hyper-V (OS dependant) up to a maximum of 127 virtual functions supported by the adapter
- Enables Low Latency RDMA over 40Gb Ethernet (supported with both non-virtualized and SR-IOV enabled virtualed servers) -- latency as low as 1 ?s
- Microsoft VMQ / VMware NetQueue support
- Sub 1 µs InfiniBand MPI ping latency
- Support for QSFP to SFP+ for 10 GbE support
- Traffic steering across multiple cores
- Legacy and UEFI PXE network boot support (Ethernet mode only)

The Mellanox ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter has the same features as the ConnectX-3 40GbE / FDR IB VPI Adapter with these additions:

- Mezzanine LOM Generation 2 (ML2) form factor
- Offers NVGRE hardware offloads
- Offers VXLAN hardware offloads

Performance

Based on Mellanox's ConnectX-3 technology, these adapters provide a high level of throughput performance for all network environments by removing I/O bottlenecks in mainstream servers that are limiting application performance. With the FDR VPI IB/E Adapter, servers can achieve up to 56 Gb transmit and receive bandwidth. Hardware-based InfiniBand transport and IP over InfiniBand (IPoIB) stateless off-load engines handle the segmentation, reassembly, and checksum calculations that otherwise burden the host processor.

RDMA over InfiniBand and RDMA over Ethernet further accelerate application run time while reducing CPU utilization. RDMA allows very high-volume transaction-intensive applications typical of HPC and financial market firms, as well as other industries where speed of data delivery is paramount. With the ConnectX-3-based adapter, highly compute-intensive tasks running on hundreds or thousands of multiprocessor nodes, such as climate research, molecular modeling, and physical simulations, can share data and synchronize faster, resulting in shorter run times.

In data mining or web crawl applications, RDMA provides the needed boost in performance to enable faster search by solving the network latency bottleneck that is associated with I/O cards and the corresponding transport technology in the cloud. Various other applications that benefit from RDMA with ConnectX-3 include Web 2.0 (Content Delivery Network), business intelligence, database transactions, and various cloud computing applications. Mellanox ConnectX-3's low power consumption provides clients with high bandwidth and low latency at the lowest cost of ownership.

TCP/UDP/IP acceleration

Applications utilizing TCP/UDP/IP transport can achieve industry leading data throughput. The hardware-based stateless offload engines in ConnectX-3 reduce the CPU impact of IP packet transport, allowing more processor cycles to work on the application.

NVGRE and VXLAN hardware offloads

The Mellanox ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter offers NVGRE and VXLAN hardware offload engines which provide additional performance benefits, especially for public or private cloud implementations and virtualized environments. These offloads ensure that Overlay Networks are enabled to handle the advanced mobility, scalability, serviceability that is required in today's and tomorrow's data center. These offloads dramatically lower CPU consumption, thereby reducing cloud application cost, facilitating the highest available throughput, and lowering power consumption.

Software support

All Mellanox adapter cards are supported by a full suite of drivers for Microsoft Windows, Linux distributions, and VMware. ConnectX-3 adapters support OpenFabrics-based RDMA protocols and software. Stateless offload is fully interoperable with standard TCP/ UDP/IP stacks. ConnectX-3 adapters are compatible with configuration and management tools from OEMs and operating system vendors.

Specifications

InfiniBand specifications (ConnectX-3 FDR VPI IB/E Adapter and ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter):

- Supports InfiniBand FDR-14, FDR-10, QDR, DDR, and SDR
- IBTA Specification 1.2.1 compliant
- RDMA, Send/Receive semantics
- Hardware-based congestion control
- 16 million I/O channels
- 256 to 4 KB MTU, 1 GB messages
- Nine virtual lanes: Eight data and one management
- NV-GRE hardware offloads (ConnectX-3 Pro only)
- VXLAN hardware offloads (ConnectX-3 Pro only)

Enhanced InfiniBand specifications:

- Hardware-based reliable transport
- Hardware-based reliable multicast
- Extended Reliable Connected transport
- Enhanced Atomic operations
- Fine-grained end-to-end quality of server (QoS)

Ethernet specifications:

- IEEE 802.3ae 10 GbE
- IEEE 802.3ba 40 GbE (ConnectX-3 FDR VPI IB/E Adapter and ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter)
- IEEE 802.3ad Link Aggregation
- IEEE 802.3az Energy Efficient Ethernet
- IEEE 802.1Q, .1P VLAN tags and priority
- IEEE 802.1Qbg
- IEEE P802.1Qaz D0.2 Enhanced Transmission Selection (ETS)
- IEEE P802.1Qbb D1.0 Priority-based Flow Control
- IEEE 1588v2 Precision Clock Synchronization

- Multicast
- Jumbo frame support (9600B)
- 128 MAC/VLAN addresses per port

Hardware-based I/O virtualization:

- Address translation and protection
- Multiple queues per virtual machine
- VMware NetQueue support
- 16 virtual function SR-IOV supported with Linux KVM
- VXLAN and NVGRE (ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter)

SR-IOV features:

- Address translation and protection
- Dedicated adapter resources
- Multiple queues per virtual machine
- Enhanced QoS for vNICs
- VMware NetQueue support

Additional CPU offloads:

- TCP/UDP/IP stateless offload
- Intelligent interrupt coalescence
- Compliant with Microsoft RSS and NetDMA

Management and tools:

InfiniBand:

- Interoperable with OpenSM and other third-party subnet managers
- Firmware and debug tools (MFT and IBDIAG)

Ethernet:

- MIB, MIB-II, MIB-II Extensions, RMON, and RMON 2
- Configuration and diagnostic tools

Protocol support:

- Open MPI, OSU MVAPICH, Intel MPI, MS MPI, and Platform MPI
- TCP/UDP, EoIB and IPoIB
- uDAPL

Physical specifications

The adapters have the following dimensions:

- Height: 168 mm (6.60 in)
- Width: 69 mm (2.71 in)
- Depth: 17 mm (0.69 in)
- Weight: 208 g (0.46 lb)

Approximate shipping dimensions:

- Height: 189 mm (7.51 in)
- Width: 90 mm (3.54 in)
- Depth: 38 mm (1.50 in)
- Weight: 450 g (0.99 lb)

Supported servers

The adapters are supported in the System x servers that are listed in the following tables.

Memory requirements: Ensure that your server has sufficient memory available to the adapters. The first adapter requires 8 GB of RAM in addition to the memory allocated to operating system, applications, and virtual machines. Any additional adapters installed each require 4 GB of RAM.

Support for servers with Intel Xeon v3 processors

Table 4. Support for servers with Intel Xeon v3 processors

Part number	Description	x3100 M5 (5457)	x3250 M5 (5458)	x3500 M5 (5464)	x3550 M5 (5463)	x3650 M5 (5462)	x3850 X6/x3950 X6 (6241, E7 v3)	nx360 M5 (5465)
00D9690	Mellanox ConnectX-3 10 GbE Adapter	Y	Y	Y	Y	Y	Y	Y
00D9550	Mellanox ConnectX-3 40GbE / FDR IB VPI Adapter	N	N	Y	Y	Y	Y	Y
00FP650	Mellanox ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter	N	N	N	Y	Y	Y	Y

Support for servers with Intel Xeon v2 processors

Table 5. Support for servers with Intel Xeon v2 processors

Part number	Description	x3500 M4 (7383, E5-2600 v2)	x3530 M4 (7160, E5-2400 v2)	x3550 M4 (7914, E5-2600 v2)	x3630 M4 (7158, E5-2400 v2)	x3650 M4 (7915, E5-2600 v2)	x3650 M4 BD (5466)	x3650 M4 HD (5460)	x3750 M4 (8752)	x3750 M4 (8753)	x3850 X6/x3950 X6 (3837)	x3850 X6/x3950 X6 (6241, E7 v2)	dx360 M4 (E5-2600 v2)	nx360 M4 (5455)
00D9690	Mellanox ConnectX-3 10 GbE Adapter	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
00D9550	Mellanox ConnectX-3 40GbE / FDR IB VPI Adapter	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
00FP650	Mellanox ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N

Support for servers with Intel Xeon v1 processors

Table 6. Support for servers with Intel Xeon v1 processors

Part number	Description	x3100 M4 (2582)	x3250 M4 (2583)	x3300 M4 (7382)	x3500 M4 (7383, E5-2600)	x3530 M4 (7160, E5-2400)	x3550 M4 (7914, E5-2600)	x3630 M4 (7158, E5-2400)	x3650 M4 (7915, E5-2600)	x3690 X5 (7147)	x3750 M4 (8722)	x3850 X5 (7143)	dx360 M4 (7912, E5-2600)
00D9690	Mellanox ConnectX-3 10 GbE Adapter	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
00D9550	Mellanox ConnectX-3 40GbE / FDR IB VPI Adapter	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
00FP650	Mellanox ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter	N	N	N	N	N	N	N	N	N	N	N	N

Supported operating systems

The adapters support the following operating systems. Check Fix Central for currently supported OS kernels:
http://ibm.com/support/fixcentral

For the Mellanox ConnectX-3 10 GbE Adapter:

- Microsoft Windows Server 2008 R2
- Microsoft Windows Server 2012 R2
- Red Hat Enterprise Linux 5 Server x64 Edition
- Red Hat Enterprise Linux 6 Server x64 Edition
- Red Hat Enterprise Linux 7
- SUSE Enterprise Linux Server (SLES) 12
- SUSE LINUX Enterprise Server 10 for AMD64/EM64T
- SUSE LINUX Enterprise Server 11 for AMD64/EM64T
- VMware vSphere 5.0 (ESXi)
- VMware vSphere 5.1 (ESXi)
- VMware vSphere 5.5 (ESXi)
- VMware vSphere 6.0 (ESXi)

For the Mellanox ConnectX-3 40GbE / FDR IB VPI Adapter:

- Microsoft Windows Server 2008 R2
- Microsoft Windows Server 2012 R2
- Red Hat Enterprise Linux 5 Server x64 Edition
- Red Hat Enterprise Linux 6 Server x64 Edition
- Red Hat Enterprise Linux 7
- SUSE Enterprise Linux Server (SLES) 12
- SUSE LINUX Enterprise Server 10 for AMD64/EM64T
- SUSE LINUX Enterprise Server 11 for AMD64/EM64T
- VMware vSphere 5.0 (ESXi)
- VMware vSphere 5.1 (ESXi)
- VMware vSphere 5.5 (ESXi)

For the Mellanox ConnectX-3 Pro ML2 2x40GbE/FDR VPI Adapter:

- Microsoft Windows Server 2012 R2
- Red Hat Enterprise Linux 6 Server x64 Edition
- Red Hat Enterprise Linux 7
- SUSE Enterprise Linux Server (SLES) 12
- SUSE LINUX Enterprise Server 11 for AMD64/EM64T
- VMware vSphere 5.1 (ESXi)
- VMware vSphere 5.5 (ESXi)
- VMware vSphere 6.0 (ESXi)

Note:

- VXLAN is initially supported only with Red Hat Enterprise Linux 7
- NVGRE is initially supported only with Windows Server 2012 R2

Note on VMware support: With VMware, these adapters are supported only in Ethernet mode. InfiniBand is not supported.

Regulatory approvals

- EN55022
- EN55024
- EN60950-1
- EN 61000-3-2
- EN 61000-3-3
- IEC 60950-1
- FCC Part 15 Class A
- UL 60950-1
- CSA C22.2 60950-1-07
- VCCI
- NZ AS3548 / C-tick
- RRL for MIC (KCC)
- BSMI (EMC)
- IECS-003:2004 Issue 4

Operating environment

The adapters are supported in the following environment:

Operating temperature:

- 0 - 55° C (-32 to 131° F) at 0 - 914 m (0 - 3,000 ft)
- 10 - 32° C (50 - 90° F) at 914 to 2133 m (3,000 - 7,000 ft)

Relative humidity: 20% - 80% (noncondensing)
Maximum altitude: 2,133 m (7,000 ft)
Air flow: 200 LFM at 55° C

Power consumption:

- Power consumption (typical): 8.8 W typical (both ports active)
- Power consumption (maximum): 9.4 W maximum for passive cables only,
- 13.4 W maximum for active optical modules

Warranty

One year limited warranty. When installed in an System x server, these cards assume your system's base warranty and any warranty upgrades.

Related publications

For more information, refer to these documents:

- U.S. Announcement Letter
  http://ibm.com/common/ssi/cgi-bin/ssialias?infotype=dd&subtype=ca&&htmlfid=897/ENUS113-008

- System x networking adapters
  http://shop.lenovo.com/us/en/systems/servers/options/systemx/networking/adapters/

- ServerProven compatibility
  http://www.lenovo.com/us/en/serverproven/xseries/lan/matrix.shtml

- Mellanox User Manual - Mellanox ConnectX-3 40GbE / FDR IB VPI Adapter
  http://bit.ly/YJ3R0x

- Mellanox User Manual - Mellanox Connect X-3 10GbE Adapter
  http://bit.ly/YJ4oQa

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